

SHAFT SUPPORT STRUCTURE

DESCRIPTION OF THE INVENTION

[0001] The present invention relates to a shaft support structure, which includes an elongated shell having a hollow interior, and a plurality of reinforcing ribs of plastic material located within the hollow interior of the shell. The reinforcing ribs are fixedly attached to the shell, and define a longitudinal passage through the shell for receiving and supporting a rotatable shaft, e.g., a steering shaft, therein.

[0002] Rotatable shafts, such as automotive steering shafts and actuating shafts used in aircraft, typically must be supported along at least a portion of their length. Support of a rotatable shaft is generally necessary for reasons which include, stabilization of the shaft, e.g., minimizing flexing of the shaft during operation, lessening or minimizing the support load requirements on that which drives the shaft and that which is driven by the shaft, and protecting the shaft from damage.

[0003] In, for example, the transportation industry (e.g., the automotive and aircraft industries) it is desirable to minimize the weight of the vehicle or aircraft in an effort towards maximizing fuel efficiency. The total weight of a vehicle or aircraft can be reduced by reducing the weight of its components. However, it is generally required that the strength and rigidity of a component not be compromised as the weight of the component is reduced.

[0004] It is known that a component having a unitary molded plastic structure, formed for example by injection molding, can have reduced weight relative to an equivalent component fabricated from metal.

[0005] However, unitary molded plastic parts typically have lower strength and rigidity compared to equivalent parts fabricated from metal.

[0006] It would be desirable to develop a shaft support structure that has reduced weight. It is also desirable that the shaft support structure have, in addition to reduced weight, good strength and rigidity.

[0007] U.S. Pat. No. 5,190,803 describes a lightweight structural component having high strength and rigidity, which includes a bowl-shaped shell, e.g., fabricated from metal, and injected-on plastic reinforcing ribs located within the interior of the shell. The plastic reinforcing ribs are described in the '803 patent as being connected to the shell at discrete connecting points by means of perforations in the shell through which the plastic extends and in which the edges of the perforations are embedded. The '803 patent does not describe structural components that support internally a separate component passing through the interior of the structural component.

[0008] In accordance with the present invention, there is provided a shaft support structure comprising:

[0009] (a) an elongated shell having interior surfaces which define a hollow interior; and

[0010] (b) a plurality of reinforcing ribs of plastic material located within the hollow interior of said shell, at least a portion of said reinforcing ribs being in abutting relationship with the interior surfaces of said shell, said reinforcing ribs defining a longitudi-

nal passage through said elongated shell for receiving and supporting a rotatable shaft, and said reinforcing ribs being fixedly attached to said elongated shell.

[0011] In further accordance with the present invention, the shaft support structure comprises:

[0012] (a) an elongated shell having interior surfaces which define a hollow interior, said shell having a plurality of perforations having edges; and

[0013] (b) a plurality of reinforcing ribs of plastic material located within the hollow interior of said shell, at least a portion of said reinforcing ribs being in abutting relationship with the interior surfaces of said shell, said reinforcing ribs defining a longitudinal passage through said elongated shell for receiving and supporting a rotatable shaft,

[0014] wherein said reinforcing ribs are formed by molding, e.g., injection molding, of plastic material onto the interior surfaces of said shell, and a portion of the plastic material of said reinforcing ribs extends through at least some of said perforations of said shell, the edges of said perforations being embedded in the plastic material extending therethrough, thereby attaching fixedly said reinforcing ribs to said shell.

[0015] The features that characterize the present invention are pointed out with particularity in the claims, which are annexed to and form a part of this disclosure. These and other features of the invention, its operating advantages and the specific objects obtained by its use will be more fully understood from the following detailed description and accompanying drawings in which preferred embodiments of the invention are illustrated and described.

[0016] Unless otherwise indicated, all numbers or expressions, such as those expressing structural dimensions, quantities of ingredients, etc. used in the specification and claims are understood as modified in all instances by the term "about."

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. 1 is a perspective view of a shaft support structure according to the present invention;

[0018] FIG. 2 is a perspective view of the shaft support structure of FIG. 1, in which the shaft support structure has been rotated 180° around its longitudinal axis;

[0019] FIG. 3 is a sectional representation of perforation edges embedded in the plastic material extending therethrough;

[0020] FIG. 4 is a sectional representation of plastic embedded perforation edges, in which the plastic material defines a substantially plastic lined aperture;

[0021] FIG. 5 is a sectional representation of deformed perforation edges embedded in the plastic material extending therethrough; and

[0022] FIG. 6 is a sectional representation of deformed perforation edges embedded in the plastic material extending therethrough.

[0023] In FIGS. 1 through 6, like reference numerals designate the same components and structural features.